# An evaluation guideline for prognostic microscale wind field models

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- Purpose of guideline
- Structural details
- Results and conclusions

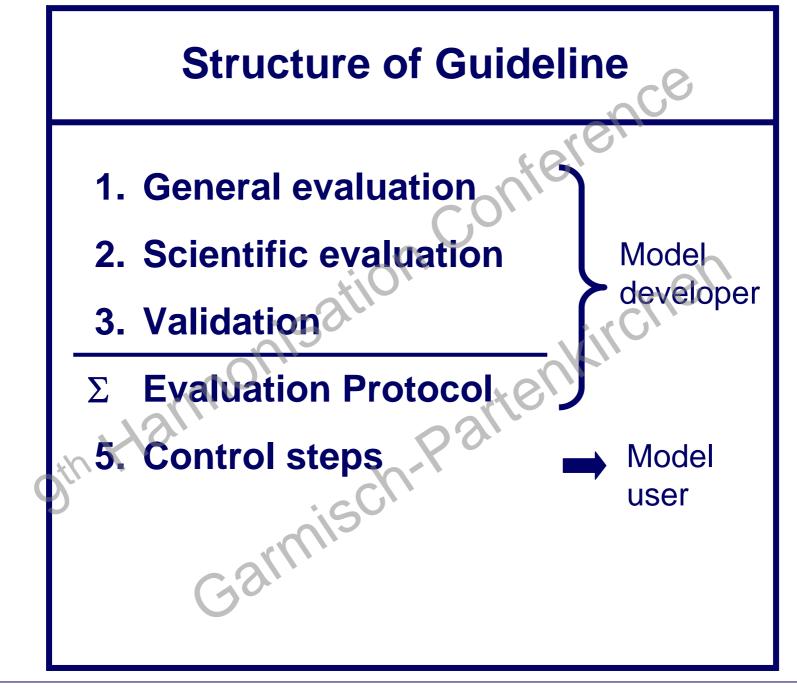


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# **Purpose of Guideline**

- Allow a quantitative model evaluation.
- Evaluation of models for simulations of the flow fields within the urban canopy layer.
- Hints for improvements of models.
- Evaluation of the performance of single models.
- Comparison of model performance from different models and thereby detection of general model shortcomings (and thus deficits in our scientific understanding) in contrast to single model deficits.







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# **1. General evaluation**

- Comprehensibility
  - Documentation must be available
  - Source code open for inspection
  - Three publications in refereed journals
- Documentation
  - Short model description
  - Extended model description
  - User manual
  - Technical reference

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# **2. Scientific evaluation**

- All three wind components calculated from prognostic equations.
- Use of continuity equation or the anelastic approximation.
- Calculation of continuous fluxes (with respect to stratification and/or height).
- Direct calculation of the fluxes close to rigid boundaries or employment of wall functions.
- Symmetry of the Reynolds stress tensor.
- Explicit treatment of buildings.

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Consideration of building roughness.

# 3. Validation

- Model evaluation for selected cases
  - Specification of test cases
  - Evaluation criteria
- Specification of grid structure
- Additional on-line tests
  - No 2  $\Delta$ t-oscillations
  - mass conservation

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no exceedance of threshold values

#### **Test cases**

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	Kind of building	Tested quality	Comparison data set
a1	quasi 2d building	Scaling	M a1-1
a2	quasi 2d building	Stationarity	M a1-2
a3	1 building	Grid size dependence	M a3-1
b-1	no building	Development of boundary layer	A b-1
b-2	no building	Dependence on direction of incoming flow	M b-1
b-7	no building	Coriolis force	A b-7, M b-1
b-8	no building	Coriolis force and direction of incoming flow	M b-7
c1	quasi 2d building	Advection, turbulence	W c1, A c1
c2	quasi 2d building	Advection, turbulence	M a1-2, A c2
c3	1 building	Advection, turbulence	W c3
c4	1 building	Direction of incoming flow	W c4
c5	1 building	Width of building	W c5
c6	several buildings	Flow interaction between buildings	W c6



### **Evaluation measure**

Hit rate q:

percentage of model results P<sub>i</sub> within an allowed

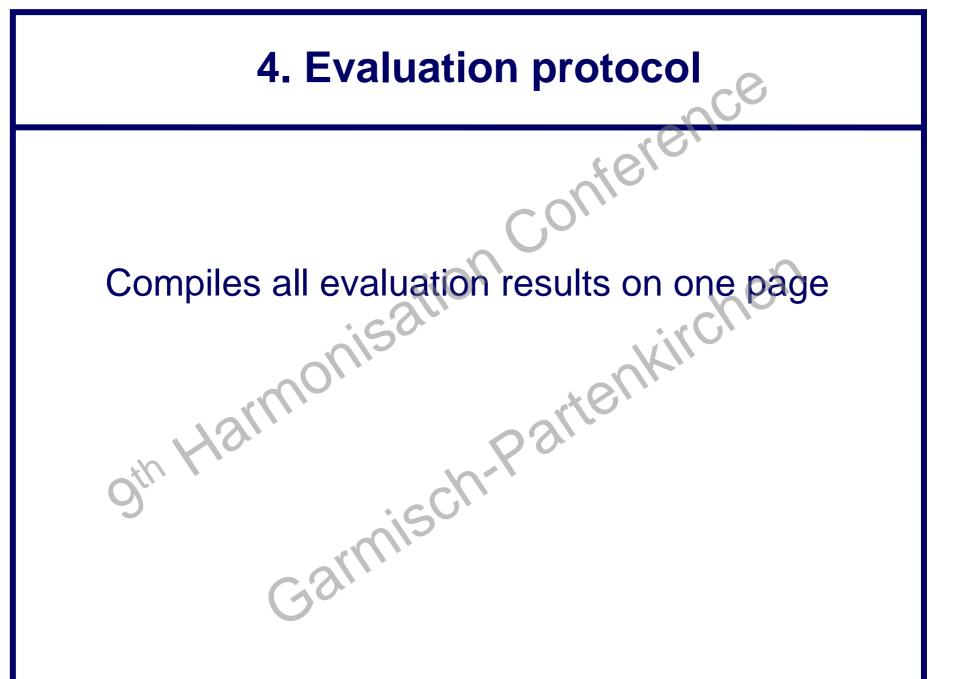
- relative difference D and
- absolute difference W from measured data O<sub>i</sub>.

 $q = \frac{N}{n} = \frac{1}{n} \sum_{i=1}^{n} N_i \text{ with } N_i = \begin{cases} 1 \text{ for } \left| \frac{P_i - O_i}{O_i} \right| \le D \text{ or } \left| P_i - O_i \right| \le W \\ 0 \text{ else} \end{cases}$ 

#### Comparison with:

- wind tunnel data q > 66 %
- model results or analytic solutions q > 95 %.





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# 5. Control steps by model user

- Specification of grid structure.
- Quality control of model results.
  - No 2  $\Delta x$ -oscillations (inspection of cross sections).
  - check of "independence" of model results from resolution and model area size (5% differences allowed).
  - check model results for plausibility and –whenever possible- quantitatively compare with measurements and results of other models.
- Documentation of model evaluation and model limitations.

# **Guideline fulfills its purpose**

- Allows a quantitative model evaluation. (Hit rates)
- Evaluation of models for simulations of the flow fields within the urban canopy layer. (models MIMO, MISKAM, MITRAS were used)
- Hints for improvements of models
  (e.g. coding error by test cases of type b detected).
- Evaluation of the performance of single models. (all models were tested independent)
- Comparison of model performance from different models and thereby detection of general model shortcomings (and thus deficits in our scientific understanding) in contrast to single model deficits.
- (up to now mainly shortcomings in data sets)



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# **Conclusions and results**

- The application of the guideline by several modelling groups showed its usability.
- The guideline is in national review and will be available in English in summer 2005.
- Results of the application of the evaluation guideline (part 5) can be seen on the poster 1.31 by *Grawe et al.* for the microscale model MITRAS.
- Results of the application of the evaluation guideline (part 3) are presented in the following talk by *Eichhorn* for the microscale model MISKAM.



# Thank you for your attention Garmisch-Partenkirchen